

Ultra-Refractory Composites for Propulsion Applications, Phase I

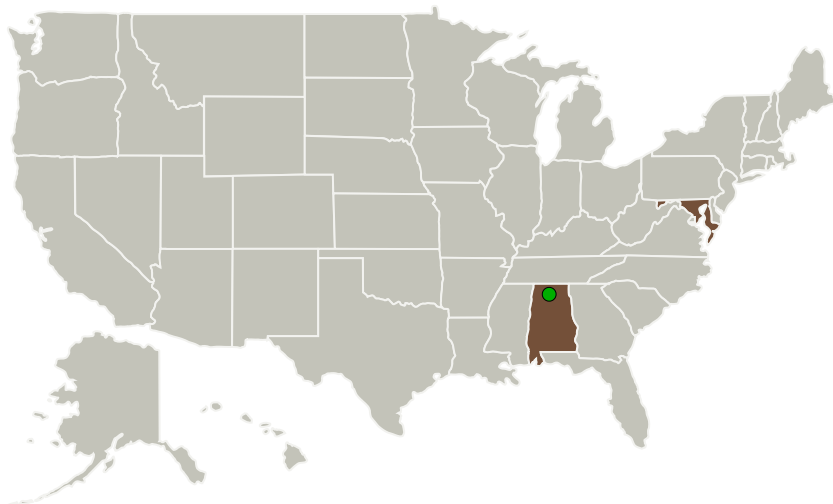
Completed Technology Project (2010 - 2010)



Project Introduction

This phase I research proposes an efficient approach to develop a reliable chemical vapor infiltration (CVI) process for HfB₂-HfC-SiC matrices for carbon fiber composites and chemical vapor deposition (CVD) processes for depositing coatings for the same compositions, and; second, to design, fabricate, and evaluate ultra-refractory CMCs consisting of a carbon fiber reinforcement reinforcing a functionally graded matrix of HfB₂-HfC-SiC graded to SiC. These advanced, lightweight materials are likely enabling for future propulsion goals. The HfB₂-HfC-SiC monolithic material has been shown to exhibit high temperature performance superior to all other materials tested under reentry conditions. The oxidation layer formed on these monolithic compositions was extremely tenacious, displaying no spallation after cooling from 2200°C. It is thought that if deposited as the matrix of a carbon fiber reinforced ceramic matrix composite, the oxide layer will prevent the ingress of species that will degrade the interfacial debond layer and the carbon fiber, allowing for the retention of mechanical properties under extreme temperatures and oxidizing environments. Thermodynamic modeling will allow for efficient optimization of the deposition conditions; High temperature oxidation testing of the fabricated composites at 4500°F will provide needed feedback to improve the design for the Phase II work.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
Technology Assessment & Transfer, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Annapolis, Maryland
● Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations

Alabama	Maryland
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Project Transitions

▶ **January 2010:** Project Start

✓ **September 2010:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/139511>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Technology Assessment & Transfer, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

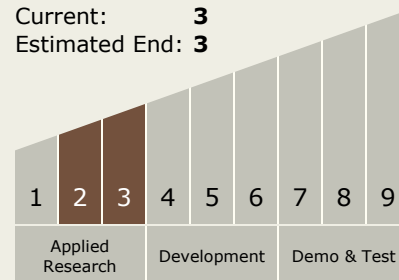
Steven M Seghi

Technology Maturity (TRL)

Start: **2**

Current: **3**

Estimated End: **3**



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Technology Areas

Primary:

- TX01 Propulsion Systems
 - └ TX01.1 Chemical Space Propulsion
 - └ TX01.1.3 Cryogenic

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System